Managing Flexibility and Uncertainty in Markets and Operations

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Congcong Wang, Market Design
Steve Rose and Long Zhao, Market R&D
Ryan Sutton, Market Innovation and Solutions
Summary

Purpose
• Discuss MISO on-going efforts to manage flexibility and uncertainty

Key Takeaways
• Operation challenges arise from uncertainty and extreme events
• Opportunities exist to improve ramp management and ancillary services in the near term
• Key elements are to quantify system flexibility needs and define available supply
As the system trends toward de-marginalization, MISO faces uncertainty across multi-timescales

- How much confidence do we have in the forecast (load, renewables, etc.) => “Define a cone of uncertainty”
- For those days that fall out of the confidence interval, how do we manage the gap => “Embrace the things that don’t fit”

Uncertainties across multiple timescales

An Extreme Event on January 30, 2019

![Graph showing uncertainties across multiple timescales and an extreme event on January 30, 2019]
Through a holistic review of markets and operations, MISO identifies flexibility actions

- Are current operation processes fully utilizing resource flexibility attributes?
- Are market incentives in place for resources to provide their flexibility at the right times and locations?

Diagram:
- Unlock resource flexibility
- Create new flexibility services
- Remove participation barrier
- Enhance price formation

- Stochastic optimization
- Intra-hour commitment
- Look-ahead dispatch, ...
- Ramp Product
- Fast AGC
- Short-Term reserve, ...
- Energy Storage
- Distributed Energy Resource
- Demand Response, ...
- Shortage pricing
- 5min settlement
- Extended LMP, ...

Unlock resource flexibility
Create new flexibility services
Remove participation barrier
Enhance price formation
Near-term Enhancements: Day-Ahead Intra-hour Flexibility

- Traditional Day-Ahead Unit Commitment assumes linear load changes between hourly intervals
- The actual load may vary more rapidly, requiring intra-hour flexibility to manage ramping
  - Sub-hourly unit commitment
  - Headroom (rampable capacity) constraint: implemented 2010
- Ramping needs could also arise from supply side when units coming on/offline at the same time
  - Recently improved implementation to account for ramping needs at evening periods when units shutdown

![Diagram showing headroom and rampable capacity changes](image-url)
Real-Time Regulation Enhancement

- Unit’s regulation clearing in SCED is limited to “REG-committed” resources by SCUC due to different operational limits*
- As system conditions change in Real-Time, the limited pool may be short to provide regulation and units need to be added on REG
- Recently built the manual process in software and improved the resource selection in order not to strand capacity or flexibility

*Note: reg capacity ≤ econ capacity; bi-directional ramp ≤ up/dn ramp
SCED: Security Constrained Economic Dispatch; SCUC: Security Constrained Unit Commitment
Enhancement of Ramp Management

- Ramp challenges exist when fast-ramping units are shutdown at evening periods.
- Ramp Capability Product can help to procure the flexibility, but may not be fully utilized if SCED accounts for inaccurate MW from units fast ramping offline.
- A shut down curve is being developed by using historical data analysis and real-time calibration:

\[ G_{t} = a_{t}SE_{t-10\text{min}}, \ t = 1, \ldots, T_{\text{stop}} \]

Where \( a_{t} \) is a scaling factor based on historical data; and SE is the State Estimator unit output.
On-going research to quantify uncertainty

- Instead of a point forecast, confidence intervals are being evaluated

- System flexibility needs are also being projected for future scenarios with high renewable penetration

![Graph showing MISO 7 Days Load Peak forecast and a simulation of 40% renewable energy scenario.](image)
Measure supply of capacity/flexibility

- Generation outages and de-rates can be sizable. What can we learn from historical data?

Gas supply and low temperature causing sizable outages/de-rates

Outages/de-rates can show regionally

Can we project resource availability day-to-day?

- Desired features of a flexibility measure:
  - Be technology neutral
  - Assess collective flexibility
Questions?